REMARKS

Claims 1 and 46-48 have been amended. Claims 6, 11-13, 16 and 17 have been canceled. Claims 1, 7-10 and 46-52 are now pending in this application. Applicants reserve the right to pursue the original and other claims in this and other applications.

At the outset, Applicants respectfully submit that chemical vapor deposition (CVD), the process referenced in Kelly, Fong, and Henley, is a chemical process often used in the semiconductor industry for the deposition of thin films of various materials. In a typical CVD process, the substrate is exposed to one or more volatile precursors, which react and/or decompose on the substrate surface to produce the desired deposit. Frequently, volatile byproducts are also produced, which are removed by gas flow through the reaction chamber. CVD is widely used in the semiconductor industry, as part of the semiconductor device fabrication process, to deposit various films.

Atomic layer deposition (ALD), on the other hand, is a self-limiting, sequential surface chemistry that deposits conformal thin-films of materials onto substrates of varying compositions. ALD is a film growth technology that is capable of depositing uniform and conformal films with atomic precision. ALD is similar in chemistry to CVD, except that the ALD reaction breaks the CVD reaction into two half-reactions, keeping the precursor materials separate during the reaction. ALD film growth is self-limited and based on surface reactions, which makes achieving atomic scale deposition control possible. By keeping the precursors separate throughout the coating process, atomic layer control of film grown can be obtained as fine as ~ 0.1 angstroms per monolayer. ALD has an advantage over CVD in several areas, as ALD grown films are conformal, pin-hole free, and chemically bonded to the substrate (as is CVD). Therefore, one, ALD is distinct from CVD and additionally one of ordinary skill in the art would not look to a CVD process lacking the abilities of ALD to improve an ALD process.

Claims 1, 6-8, 10-17 and 49 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Kelly (U.S. Patent No. 5,071,670) in view of Fong (U.S. Patent No. 5,935,334). The rejection is respectfully traversed. Claims 6, 11-13, 16 and 17 have been canceled and thus, this rejection is no longer applicable to these claims.

Claim 1 recites an atomic layer doping apparatus comprising "a central loading robot assembly for moving [the] first substrate back and forth between a first substrate holder in [the] first doping region laterally through [the] vertical inert gas curtain and a second substrate holder in [the] second doping region."

Kelly relates to a sequential CVD apparatus in a single reactor vessel 12. In particular, the reaction-containing pressure vessel 12 of Kelly consists of "[t]wo gas sources 14 and 16 [that] are contained within the interior of the vessel 12 and [which] direct their respectively different gases upwardly through gas emission plates 18 and 20." (Column 4, lines 13-16). In other words, the substrate in Kelly will be subjected to two distinct gaseous environments within the same doping region without any physical barriers between the two environments. (*See* column 4, lines 32-35). This is contrary to the claimed invention where an inert gas curtain is provided between the two atomic layer doping regions to prevent the cross contamination of the first and second gas species. The claimed invention comprises two atomic layer doping regions whereas Kelly discloses only one.

Moreover, Kelly discloses a rotating substrate plate that is rotated by a shaft in a counter-clockwise direction extending around the shaft. (Kelly at column 5, lines 33-35). Kelly does not disclose or suggest "a central loading robot assembly for moving [the] first substrate back and forth between a first substrate holder in [the] first doping region laterally through [the] vertical inert gas curtain and a second substrate holder in [the] second doping region" for at least two reasons. First, the substrate in the claimed

invention is moved from one substrate holder to another and not rotated on a substrate plate. Secondly, the substrate plate of Kelly rotates in one direction, i.e., counter-clockwise, and not "back and forth between" doping regions. Thus, the Kelly structure and the claimed invention are completely different from each other.

Further, Kelly teaches that there are no physical barriers that separate the two environments e1 and e2 (FIG. 1; *see also* column 4, lines 28-35). Kelly refers to neither an inert gas curtain or any other type of physical barrier. Hence, Kelly cannot disclose an atomic layer doping apparatus having "a vertical inert gas curtain" that chemically isolates the two atomic layer doping regions from each other. In the claimed invention, the structure comprises a physical barrier, i.e., a vertical inert gas curtain, that separates the first atomic layer doping region from the second atomic doping region.

In an effort to satisfy the shortcomings of Kelly, the Office Action combines Fong with Kelly. Fong is cited by the Office Action as teaching a first atomic layer region used for deposition and a second atomic layer region used for thermal diffusion of the dopant species. However, even assuming the Office Action's statement regarding Fong to be true, which Applicants do not concede, Fong does not teach or suggest an atomic layer doping apparatus comprising "a first atomic layer doping region" and "a second atomic layer doping region, different from said first atomic doping region," where the two atomic layer doping regions are "chemically isolated from one another by a vertical inert gas curtain."

Moreover, Fong fails to teach or suggest "a central loading robot assembly for moving [the] first substrate back and forth between a first substrate holder in [the] first doping region laterally through [the] vertical inert gas curtain and a second substrate holder in [the] second doping region." In fact, Fong does not refer to any structure equivalent to "a central loading robot assembly."

Therefore, Fong does not satisfy or cure the shortcomings of Kelly. For at least the reasons set forth above, Kelly and Fong do not, and cannot teach or suggest all limitations of claim 1. Nor would it have been obvious to one of ordinary skill in the art to combine the cited references to achieve the claimed invention.

Claims 7, 8, 10 and 49 depend from claim 1 and should be allowable along with claim 1. Accordingly, Applicants respectfully request that the rejection be withdrawn and the claims allowed.

Claim 9 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Kelly, Fong, and Henley (U.S. Patent No. 6,207,005). Claims 46 and 50 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Kelly in view of Fong and Gattuso (European Patent Application No. 060626). Claims 47 and 51 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Kelly in view of Fong and Hartig (U.S. Patent No. 5,382,126). The rejections are respectfully traversed.

Claim 9 depends from claim 1 and thus recites the limitations described above. Claim 46 recites "a central loading robot assembly for moving [the] first substrate back and forth between a susceptor in [the] first doping region and a susceptor in [the] second doping region laterally through [a] substantially vertical inert gas curtain." Claim 47 recites "a central loading robot assembly for moving said first substrate back and forth between a first substrate holder in [the] first doping region and a second substrate holder in [the] second doping region laterally through [a] vertical inert gas curtain."

For at least the reasons set forth above, Kelly and Fong fail to teach or suggest an atomic layer doping apparatus comprising a central loading robot assembly for moving the first substrate back and forth between a first substrate holder in the first

doping region and a second substrate holder in the second doping region through a vertical inert gas curtain.

The Office Action combines additional references Henley, Gattuso and Hartig to cure the shortcomings of Kelly and Fong for certain claim limitations. However, Henley, Gattuso and Hartig have the same shortcomings as the other cited references. Henley is cited as teaching an apparatus comprising a third pair of atomic layer doping regions. Gattuso is cited as teaching an inert gas curtain provided at a higher pressure than the first dopant species. Hartig is cited as teaching a separate gas exhaust for each region in a multi-chamber coating apparatus. However, the cited references, Henley, Gattuso and Hartig, do not teach or suggest an atomic layer doping apparatus comprising a central loading robot assembly for moving the first substrate back and forth between a first substrate holder in the first doping region and a second substrate holder in the second doping region laterally through said vertical inert gas curtain as recited in the claims. Thus, the additionally cited references do not cure the deficiencies of the Kelly and Fong combination and fail to teach or suggest all limitations of the claimed inventions. Nor would it have been obvious to one of ordinary skill in the art to combine the cited references to achieve the claimed invention.

Therefore, claims 9, 46 and 47 should be allowable. Claim 50 depends from claim 46 and is allowable along with claim 46. Claim 51 depends from claim 47 and is allowable along with claim 47. Accordingly, Applicants respectfully request that the rejections be withdrawn and the claims allowed.

Claim 48 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Maeda (U.S. Patent No. 5,314,538) in view of Fong. The rejection is respectfully traversed.

Claim 48 recites an atomic layer doping apparatus comprising "a central loading robot assembly for moving [the] first substrate back and forth between a first substrate holder in [the] first doping region and a second substrate holder in [the] second doping region laterally through [a] closeable opening of [the] vertical physical barrier."

Maeda relates to a multi-processing apparatus consisting of three separate components. In particular, Maeda refers to an apparatus having a CVD reaction chamber for forming a film on a wafer and a heat-processing chamber. Contrary to the claimed invention, Maeda's apparatus is not capable of providing a plurality of atomic layer deposition reactor chambers. Maeda relates to a multi-processing apparatus having components including a single CVD reaction chamber and a heat-processing chamber. Thus, Maeda only refers to one reaction chamber. Maeda's apparatus is only capable of the single deposition region and a processing region (*i.e.*, heat-treatment region). Therefore, Maeda's apparatus does not refer to a first and second deposition regions as in the claimed invention.

Moreover, Maeda does not disclose or suggest "a central loading robot assembly for moving [the] first substrate back and forth between a first substrate holder in [the] first doping region and a second substrate holder in [the] second doping region laterally through [a] closeable opening of [the] vertical physical barrier." In Maeda, the wafer holders are rotated around the rotary shaft in a plane by rotating a rotary shaft and rotates in a counter-clockwise direction. Maeda is not capable of moving "back and forth between" doping regions as in the claimed invention.

The Office Action seeks to overcome the deficiencies of Maeda by combining it with Fong. However, as described above, Fong adds nothing to rectify the deficiencies of Maeda. Fong does not disclose or suggest an apparatus having a first

atomic layer doping region, a second atomic layer doping region and "a central loading robot assembly for moving [the] first substrate back and forth between a first substrate holder in [the] first doping region and a second substrate holder in [the] second doping region laterally through [a] closeable opening of [the] vertical physical barrier."

Therefore, Maeda and Fong, whether considered alone or in combination, fail to teach or suggest all limitations of claim 48. Moreover, it would not have been obvious to one of ordinary skill in the art to combine the cited references to achieve the claimed invention. Accordingly, Applicants respectfully request that the rejection be withdrawn and the claim allowed.

In view of the above amendment, Applicants believe the pending application is in condition for allowance.

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Respectfully submitted,

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